



# DEVELOPING A DYNAMIC, REAL-TIME IT INFRASTRUCTURE WITH RED HAT INTEGRATED VIRTUALIZATION

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## INTRODUCTION

Businesses today face the key challenge to scale their infrastructure to meet customer demands while IT budgets are falling, or at best, flattening.

The CIO and IT managers are being asked to support new business initiatives by rapidly delivering new applications and services and to improve service levels and reliability – all within a climate of increased regulatory control and reduced budgets.

The exponential growth of IT infrastructures within the last decade has left a legacy of high costs, poor manageability, and an infrastructure that's rigid and inflexible.

Server sprawl is commonplace, with large numbers of under utilized servers, often running a single application on a server that is sized to handle the peak workload, resulting in racks of servers that run at 5 to 10% of capacity for 51 weeks of the year. This inefficiency often leads to power and cooling costs that dwarf the cost of the server hardware.

The same infrastructure leaves organization unable to react quickly to support business needs, with lengthy hardware acquisition and provisioning cycles that lead to project delays and an inability to provide an agile environment.

## BENEFITS OF VIRTUALIZATION

Virtualization has begun to transform the way that enterprises are deploying and managing their infrastructure, providing the foundation for a truly agile enterprise. So IT can deliver an infrastructure that is flexible, scalable, and most importantly economical by efficiently utilizing resources.

Virtualization has shown a number of clear benefits to the IT organization:

### Server consolidation

In most data centers servers typically run at low utilization rates, often between 10 to 15% of capacity for 364 days of the year. With virtualization it is possible to consolidate the load of a number of these lightly loaded servers onto one physical server, reducing hardware costs, physical space requirements, and power and cooling costs.

### Hardware independence

Virtualization provides an abstraction layer between the operating system and the underlying hardware. This decoupling of the operating system breaks the traditional one-to-one relationship of applications to servers and gives customers flexibility in deployment.

Hardware abstraction allows organizations to deploy legacy operating systems and applications on new hardware. With this hardware independence virtual machines can be transparently deployed on different hardware platforms; for example, the virtual machine sees the same virtual hardware when deployed on different platforms for production, QA, development, or even disaster recovery.

### Business agility

Virtualization provides the foundation for real business agility, allowing IT to respond to business needs by rapidly provisioning new servers. Or dynamically add resources to an existing server to handle increased demand. Migrate a virtual machine between hosts to balance workloads or reduce maintenance downtime.



## Application isolation

With virtualization it is easy to encapsulate an application together with its operating system, performance, and configuration parameters, security environment, etc., into a single entity. This encapsulation enables applications to be tightly controlled and managed, immune from other changes in the IT environment.

## VIRTUALIZATION CHALLENGES

Virtualization is rapidly becoming mainstream in today's data center with most organizations deploying virtualization somewhere within their infrastructure. But despite this widespread deployment, virtual machines still only account for a very small percentage of servers in the data center, typically around 5% to 10% of systems.

The first generation of proprietary virtualization solutions have typically been deployed in development and test environments or for consolidation of non critical workloads. A number of issues have prevented organizations from leveraging the benefits of virtualization widely across their infrastructure.

**Performance.** The traditional virtualization products have relied on hardware emulation, intercepting and translating hardware requests from the guest virtual machines. This approach creates significant overhead, especially for I/O intensive workloads, and limits the scalability of the virtual environment. For this reason enterprise class workloads such as databases or ERP systems are seldom virtualized in production.

**Cost.** Proprietary virtualization solutions typically cost between \$5,000 and \$10,000 per host and often require new hardware to be purchased to run the virtualization software, both to provide a higher end system to handle the overhead and because of restrictive hardware compatibility list. The high cost of virtualization typically restricts deployments to projects where costs can quickly be recouped, for example projects with high consolidation rates: 10-20 servers per host.

**Manageability.** While virtualization solutions often provide rich management tools, they are limited to managing a single environment. In this model IT must use one set of tools to deploy, manage, monitor, and back up virtualized systems and another set of tools to handle regular server deployments, one solution to handle high availability and clustering for virtual machines and another solution for physical machines. This leads to a siloed data center with duplication in management tools, personnel, and technologies that's adding a new layer of complexity and overhead and increasing operating expenses, offsetting the gains offered by virtualization.

## RED HAT INTEGRATED VIRTUALIZATION

Red Hat Enterprise Linux 5 Advanced Platform is the first complete open source solution that provides fully integrated, commercial-strength, server and storage virtualization.

Based on the open source Xen project, Red Hat has delivered virtualization tightly integrated into the operating system at no additional cost, allowing customers to enjoy the benefits of virtualization across their infrastructure without requiring the additional investment or added complexity of a third party solution.

Red Hat includes subscriptions for virtual machines with the cost of the operating system. Customers deploying Red Hat Enterprise Linux virtualization can deploy four Red Hat Enterprise Linux virtual machines at no addition charge. Customers deploying Advanced Platform can deploy unlimited Red Hat Enterprise Linux virtual machines on that platform, saving thousands of dollars per host over conventional solutions.



The integration of virtualization into the operating system simplifies the environment, providing a single deployment platform that allows IT to deploy their applications to meet their business needs: on standalone servers, virtual machines, or even on hosted clouds. Red Hat provides a consistent environment for deploying applications that allows customers and ISVs to take advantage of new deployment models without requiring changes to their applications.

Red Hat provides a “certify once, deploy anywhere” guarantee that ensures that the applications running on Red Hat Enterprise Linux have consistent behavior whether running on physical servers or virtualized using Red Hat’s integrated virtualization.

## FEATURES AND BENEFITS

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### PARA-VIRTUALIZATION: COOPERATIVE VIRTUALIZATION

Red Hat integrated virtualization supports para-virtualization, where the operating system kernel has been optimized to run as a virtual machine.

Para-virtualization allows the virtual machine to cooperate with the hypervisor, eliminating the need for complete system emulation. Removing this overhead results in significantly better performance, especially on I/O intensive workloads. Para-virtualization solves issues that have plagued traditional virtualization solutions, such as clock-skew, where issues synchronizing the clock between the hypervisor and multiple virtual machine causes time to be “lost” as the guest clock runs more slowly than the host.

Para-virtualized guests support dynamic resource allocation, allowing memory and CPUs to be dynamically added or removed from the guest. For example if the guest needed more CPU resources to complete a resource intensive processing job, the user could dynamically add more virtual CPUs, and when the job was completed, the extra CPUs could be removed to be reassigned to other guests.

Memory can also be added or removed on the fly, all without requiring a reboot; the guest will continue running as resources are allocated.

Red Hat delivers para-virtualized kernels for Red Hat Enterprise Linux version 4.5 (and higher) and version 5.

### FULL VIRTUALIZATION

Red Hat integrated virtualization supports fully virtualized guests, allowing unmodified guest operating systems to be run. Red Hat leverages the virtualization support features of the new Intel VT-X and AMD-V CPUs to provide high performance and low overhead support for unmodified guests.

Using full virtualization, Red Hat supports legacy Linux operating systems such as Red Hat Enterprise Linux 3 that are unable to run para-virtualized, and other operating systems such as Microsoft Windows.

Microsoft Windows Server 2000, Server 2003, XP, and Vista can be run fully virtualized as 32-bit or 64-bit guests.

To deliver the best performance, Red Hat delivers para-virtualized drivers that provide optimized network and disk drivers for the guest operating system. These drivers bypass the emulated hardware and talk directly to the hypervisor, delivering significantly improved performance.



Developing a dynamic, real-time IT infrastructure with Red Hat integrated virtualization

Red Hat provides para-virtualized drivers for the following operating systems:

- Red Hat Enterprise Linux 3 x86 and x86\_64
- Red Hat Enterprise Linux 4 x86 and x86\_64
- Red Hat Enterprise Linux 5 x86 and x86\_64
- Microsoft Windows Server 2000 32bit and 64bit
- Microsoft Windows Server 2003 32bit and 64bit
- Microsoft Windows XP 32bit and 64bit
- Microsoft Windows Vista 32bit and 64bit

### **LIVE MIGRATION**

Live Migration provides the ability to move a running virtual machine between hosts with no interruption to service.

Unlike other virtualization solutions, Live Migration ensures minimal downtime, typically with a delay of only 50 to 100ms.

Live Migration allows customers to:

- move a virtual machine between hosts without interruption.
- migrate even I/O intensive workloads such as database servers.
- perform hardware maintenance without application downtime.
- migrate the virtual machine to a new host during a maintenance window.
- dynamically balance resources within a cluster.
- move a virtual machine to a new host to free up resources to allocate to other guests.
- migrate a virtual machine from a host that may be experiencing a soft-failure.

### **CLUSTERING**

Red Hat Enterprise Linux Advanced Platform includes Red Hat Cluster Suite, which provides application and guest operating system failover capabilities.

Applications can be moved between guest operating systems on the same or different physical system, and entire virtual machines can be moved between physical systems. Applications can be monitored for correct behavior and the results used to trigger automated recovery procedures.

### **PERFORMANCE AND SCALABILITY**

Red Hat provides the most scalable and high performance virtualization platform. Using para-virtualization, Red Hat has optimized the operating system to work in a virtualized environment providing high performance I/O and scalability. For fully virtualized guests, Red Hat Enterprise Linux provides significant performance advantages over traditional virtualization solutions.

Proprietary virtualization products work well for small workloads but do not scale to enterprise class workloads such as databases and ERP systems. Using Red Hat virtualization, customers can virtualize any workload, large or small. Red Hat virtualization scales from the smallest single CPU machine to the largest 1024 processor server. Customers can virtualize even the most critical workloads such as databases and ERP systems without the overhead incurred with other virtualization solutions.



Red Hat integrated virtualization supports up to 32 virtual CPUs per virtual machine, allowing even the largest workloads to be virtualized. The leading proprietary virtualization vendor supports only four virtual CPUs per guest.

In systems using the quad core Intel and AMD CPUs, two and four processor systems are typically being deployed, providing up to 16 processing "cores." Traditional virtualization solutions can allow a guest to access a quarter of the machine's CPU resources, while Red Hat can use the full power of the machine.

Using Red Hat integrated virtualization, customers can dynamically add and remove resources as required, for example scaling their virtual database server from 2 to 16 virtual CPUs to handle peak processing load, then scale back to 2 CPUs for regular workload.

If the virtualization host is already at full capacity the guest can be live migrated to a host with spare processing cycles.

Clients typically see anywhere from 20% to 100% performance improvements by using Red Hat integrated virtualization over proprietary solutions.

## STORAGE VIRTUALIZATION

Based on Red Hat Global File System technology, storage virtualization allows multiple guests running on the same or different servers to access and share logical storage volumes and file systems. So the storage environment for every guest remains consistent, regardless of where it is running. By providing storage virtualization, Red Hat Enterprise Linux Advanced Platform allows customers to reap the full benefits of server virtualization.

Red Hat uses the underlying Linux storage foundation to provide a highly reliable and scalable storage infrastructure.

Red Hat's storage management infrastructure provides:

- online volume resizing
- volume mirroring
- volume snapshots for online file system backup, application testing, and restart
- online Data migration between storage devices
- "hot add" storage to host systems
- "hot add" storage to running virtual machines
- high availability storage with redundant I/O paths
- support for iSCSI, Fiber Channel, and Network Attached Storage (NAS)

## MANAGEABILITY

For management, Red Hat developed the libvirt management framework, delivering a hypervisor agnostic management interfacing that allows the same tools to manage multiple different hypervisors. The libvirt standard has been embraced by leading OEMs, ISVs, and operating system vendors, and today supports six different hypervisor platforms.



Red Hat delivers a number of management tools built on libvirt:

- **virsh.** A command line shell enabling customers to script and automate virtualization management.
- **Virt-Manager.** A graphical tool for managing local and remote virtual hosts, including network configuration, storage configuration, installation, and full life cycle management.
- **Conga.** A web-based management tool for deploying, configuring, and managing virtual clusters and storage.
- **Red Hat Network.** Web-based management of physical and virtual systems, including patch provisioning, patch management, and configuration file management.

## SUMMARY

Organizations need to create a more dynamic, integrated real-time IT infrastructure that allows resources to be quickly re-purposed to the most critical tasks and applications. An infrastructure that's not labor-intensive, so that savings from consolidation aren't offset by increased operational costs.

Red Hat provides a platform that spans the entire breadth of the data center, from physical servers to virtual servers; from storage management to identity management; and even beyond the walls of the data center to cover web-scaling computing such as cloud deployment.

Red Hat ties together these new diverse deployment models by building virtualization into the fabric of the infrastructure, allowing the same tools and technologies used to manage physical servers to be applied to virtualized systems and cloud environments.

Red Hat eliminates the barriers to adopting virtualization throughout the enterprise. With Red Hat, organizations get better performance and scalability from their virtualization infrastructure than from third party solutions, without requiring investment in new hardware or software licenses.

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